PE.MC3 $\quad * \; y = x^2 - x \qquad *$ Speed $= 2\sqrt{10}$ const.

$\underbrace{dx/dt}_{x'} > 0$ for all t. find $\underbrace{dy/dt}_{y'}$ @ $(2,2)$

$* \; (2\sqrt{10})^2 = 40 = x'^2 + y'^2$

$*$

$$\frac{dy}{dt} = 2x\frac{dx}{dt} - \frac{dx}{dt} \Rightarrow y' = x'(2x-1)$$

$$x' = \frac{1}{2x-1}y' \; ; \quad 40 = \left(\frac{1}{2x-1}\right)^2 y'^2 + y'^2$$

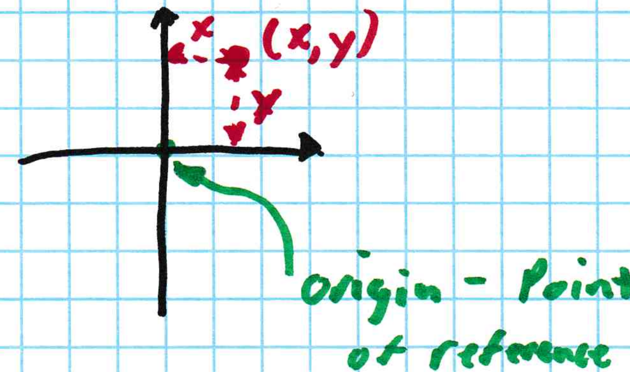
@$(2,2)$

$$y'^2\left(\frac{10}{9}\right) = 40 \; ;$$

$$y'^2 = 40 \cdot \frac{9}{10} = 36 \; ; \quad y' = \pm 6$$

Polar Coordinates

Cartesian Coordinates



r - dist to pole
- if r is (−), π rotation to point

θ - Polar angle
- radians (typically)
- (+) is counter clockwise
  (−) is clockwise
- ℝ Domain, ~~[illegible]~~ Directions repeat

⚠ Every location Has multiple coordinates

Conversions

$$r^2 = x^2 + y^2$$

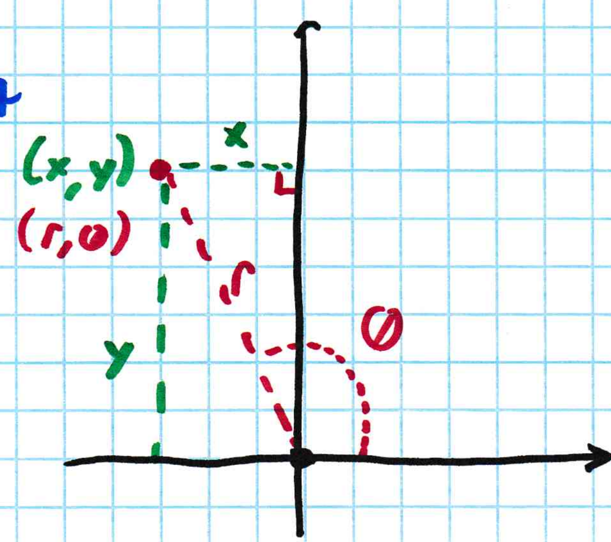
$$r \cdot \cos\theta = x$$

$$r \cdot \sin\theta = y$$

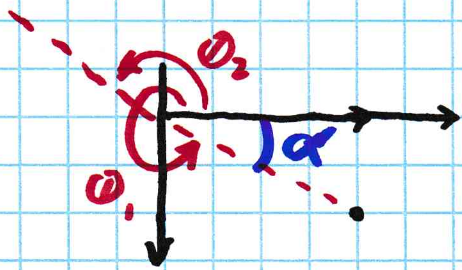
$$\tan\theta = \frac{y}{x}$$

Alignment Convention

- Pole & origin are coincident
- Polar axis is along x+



10.4.14 $(x,y) = (4,-2)$ find 2 (r,θ), $0 \le \theta < 2\pi$

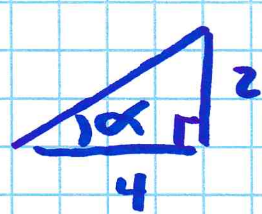


$r^2 = 16 + 4 = 20$

$r = \pm\sqrt{20} = \pm 2\sqrt{5}$

$\theta_1 = 2\pi - \alpha$

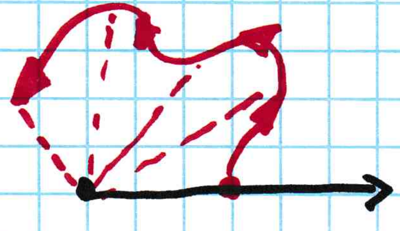
$\theta_2 = \theta_1 - \pi$



$\tan\alpha = 1/2$, $\alpha = \arctan 1/2$

$(2\sqrt{5}, 2\pi - \arctan 1/2)$, $(-2\sqrt{5}, \pi - \arctan 1/2)$

Polar Curves - typical convention $r = f(\theta)$



$dr/d\theta$: rate of change of radius with respect to angle

$r = c$ is a circle. $dr/d\theta = 0$ means radius and tangent are $\perp$

Parameterization

$x(\theta) = f(\theta) \cdot \cos\theta$, $y(\theta) = f(\theta) \cdot \sin\theta$

- tangent slope : $dy/dx = \dfrac{dy/d\theta}{dx/d\theta}$

All other parametric calculus holds same meaning